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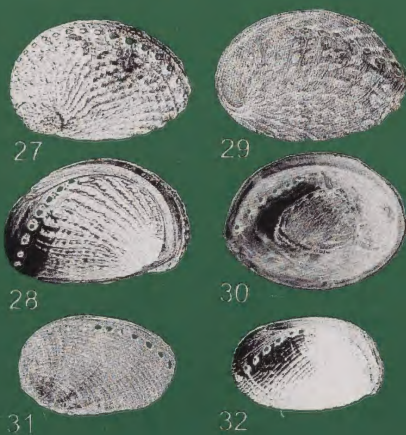
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Editors
B.J. GILL and N.J. PRICKETT

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VOLUME 39

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A CARVED STOREHOUSE AT ARAPAWAITI, WAIKANAE

ROGER NEICH

KEYWORDS: Pataka; storehouse; Arapawaiti; Waikanae; woodcarving; tribal styles; King Movement.

In 1984, while employed as an ethnologist at the National Museum of New Zealand, Wellington (now the Museum of New Zealand Te Papa Tongarewa), I arranged the purchase by that museum of two carved side panels, or rauawa, of a large pataka or raised storehouse. Subsequent research has established that these side panels belonged to a large pataka that previously stood at Arapawaiti, a Maori village on the southern side of the Waikanae River close to the present settlement of Otaihanga.

Both of the rauawa panels (Museum of New Zealand registration numbers ME.14466, ME.14467) are about 70 cm wide and 6 m long, with a pronounced transverse convex curve facing outwards, as seen on many rauawa, especially those cut from disused canoes as was a frequent practice. Lashing holes are spaced regularly along both the upper and lower edges to enable the structure of the pataka to be lashed together with plaited flax fibre rope. Equally spaced along both rauawa are four stylised full-frontal figures carved in high raised relief (Figs 1, 2), although the bodies are more naturalistic than the heads. Some of the figures have finely detailed surface decoration about their heads. The workmanship is fairly cursory, with the figures blocked out in large chisel cuts, almost certainly the work of metal tools.

Before the National Museum obtained these rauawa they were last at the Waikanae Golf Club. Oral testimony recorded at the time of purchase stated that they had been “brought from Otaki by Willie Field” (pers. comm., Peggy Lady Fleming 1984). Fortunately, a former ethnologist of the Dominion Museum, William J. Phillipps, had recorded some field notes that clearly locate these carvings to Arapawaiti, although he apparently did not know of their survival at that time:

On April 4th 1952, Mr Peter Beckett of Paraparaumu took me to visit Mrs H. Eudy living at Arapawaiti at the mouth of the Waikanae River. Here Mrs Eudy lives in a large old house once an hotel of the old coaching days, and said to be the oldest dwelling on the west coast between Wellington and Palmerston North. Mrs Eudy tells us of a pataka which when she was a child some sixty or more years ago stood in the yard of this hotel. According to Mrs Eudy it stood on six legs. Old milk cans placed upside down were used at the tops of the piles to prevent the entry of rats. On the sides were large carved boards. These were eventually given to Mr W.H. Field. (W.J. Phillipps, Ms papers, Canterbury Museum)

Mrs Hana Eudy (actually spelt “Udy”, her husband being Len Udy of the early settler family from Petone) lived in the large house at Arapawaiti that had once been the local hotel and accommodation house in the old days when the horse-drawn coach route between Wellington and the Manawatu ran along the coastal beaches. According to Ramsden (1947) who had also interviewed Mrs Udy, this house had been built in about 1843 by Tom Wilton, a

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Fig. 1. Figures carved on storehouse side panel ME.14466. Collection of the Museum of New Zealand Te Papa Tongarewa (Negative numbers B.016279–B.016282).

former whaler from Kapiti Island and his Maori wife. Ramsden reproduced a photograph of this house, but no other structures are visible nearby. Another similar photograph reproduced in Maclean (1988:169) also does not show any other structures nearby. Several other sources (eg. McLean 1988:58; Macmorran 1977:117) state that the former whaler was Tom Wilson, his wife was named Hanake Te Awaawa, and the house was built in 1848. When the coastal

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Fig. 2. Figures carved on storehouse side panel ME.14467. Collection of the Museum of New Zealand Te Papa Tongarewa (Negative numbers B.016286–B.016289).

coaching service was inaugurated some years later, their house at Arapawaiti became an important staging post for coastal travellers.

Hana Wilson, a daughter of the Wilson's, married Henry Augustus ("Harry") Field, an accomplished Maori scholar who ran the hotel from 1878 and represented Otaki in Parliament from 1896 until his death in 1899. Mr and Mrs Field lived in this Arapawaiti house and Mrs

Udy who was living there in 1952 was a foster child of the Fields. The Mr W. H. Field who received the pataka carvings during Mrs Udy's lifetime was William ("Willie"), a younger brother of Henry Field, his successor in Parliament, and the same "Willie Field" who brought the carvings to the Waikanae Golf Club from Otaki. Clearly, this information confirms that these two rauawa are from the pataka that once stood at Arapawaiti.

From these notes and the carvings, the form of the pataka can be reconstructed. It almost certainly had the standard structure of a Maori pataka, possibly with uncarved frontal boards or perhaps the original frontal carvings had been lost so that Mrs Udy remembered only the carvings on the side panels. The pataka was raised on six piles, no doubt with three on each side of the building. The upturned milk cans were a modern innovation, more effective than traditional downcurved timbers. At six metres long, this was an exceptionally large pataka, matched in size only by such outstanding historic storehouses as Te Puawai-o-Te-Arawa at Maketu and Nukutewhatewha at the Hutt Valley (Phillipps 1952).

As Mrs Udy remembered the pataka, it stood in the yard of the hotel during the 1890s and therefore probably earlier. Before the Wilson's house was built, Arapawaiti was a Maori settlement, just north of the main larger Waikanae Te Ati Awa pa of Kenakena. It is possible that the pataka had stood at Arapawaiti before 1848 as part of the original Arapawaiti Maori village. However, a search of early views of Arapawaiti by artists such as Swainson and Gilfillan, and later photographs by Adkin and others do not provide any evidence of the pataka. Consequently, it is difficult to be more specific about its construction date.

The main hapu living at Arapawaiti was named Ngati Rukao, a hapu of Te Ati Awa. Other Te Ati Awa hapu associated with Arapawaiti were Ngati Rahiri and Ngati Kaitangata (Carkeek 1966:110). Arapawaiti was also known as a "village of the Whanganui people", apparently because there had been much intermarriage with the Whanganui tribes. Just across the Waikanae River to the north of Arapawaiti was the site of the battle of Te Kuititanga, the last major tribal battle fought on this coast. This took place in 1839 between Te Ati Awa and Ngati Raukawa, both tribes being allies of Te Rauparaha who watched the progress of the fighting from a whaleboat offshore. During the battle, and afterwards in the peacemaking, the people of Arapawaiti played a prominent role. Consequently, this pataka could possibly be associated with several different tribal groups, most notably Te Ati Awa, Ngati Raukawa and Whanganui.

The eight figures on these rauawa have bodies in varying degrees of naturalism, all without any surface decoration. Five of the faces are stylised according to the usual conventions of Maori carving and have some limited surface decoration carved around their eyes and mouths. In stylistic terms, these rauawa carvings show some close relationships to the carved figures of northern Taranaki Te Ati Awa style, as seen on so many of their pataka carvings (Day 2001). One of the rauawa figures has an arm passing under a leg and with the hand to the mouth, reminiscent of the entwined sinuous figure compositions of northern Taranaki. Four have enlarged eyes tapering into lower facial areas, so frequent in northern Taranaki.

In another close stylistic relationship, the rauawa figures can be matched with low relief figures carved on a model canoe prow (Fig. 3) deposited in the Pitt Rivers Museum, Oxford, England in 1877. These canoe prow figures display elements of both Taranaki and Whanganui carving styles, perhaps suggesting an origin in the southern Taranaki tribal areas.

On one of the rauawa (ME. 14467), three of the figures have round, more naturalistic faces without any surface decoration motifs. These may suggest a relationship to Whanganui carving style.

Some other close correspondences in style are to be found on a storehouse threshold, or paepae, 283 cm long, 45 cm wide and 9 cm thick, from Otaki, now in Whanganui Regional Museum (accession number 1886.16). This paepae (Fig. 4) has four figures spaced equally

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Fig. 3. Model canoe prow with similar figures carved on the sides. Pitt Rivers Museum, Oxford PR 2075. Photos: Auckland Museum.

Fig. 4. Figures on a storehouse threshold, paepae, from Otaki. Whanganui Regional Museum 1886.16. Photos: Auckland Museum.

along its length, all of which display body configurations and facial forms similar to those on the Arapawaiti rauawa. But there are also notable and important differences on the Otaki paepae figures, especially their complete body decoration of haehae and incipient spirals, their pointed elliptical eye sockets, and their mouths wider than their eyes.

Phillipps (1952:112) has related the figures on the Otaki paepae to the type of figure carved by Te Motu Heta who was of Ngati Raukawa and Waikato descent. Te Motu Heta is credited

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Fig. 5. Te Tokanganui-a-noho house at Aotea Harbour. Photo: P. 13, Forgie Album, Negative Number C29,056, Auckland Museum.

with the carvings on the Kauwhanganui house at Ngaruawahia (Phillipps 1955:216) that include small dancing figures called Kaeaea-te-rangi by the carver Piri Poutapu. Similar figures were carved on the maihi and paepae of the former old house Te Tokanganui-a-noho (Fig. 5) at Aotea Harbour. Phillipps (1955:218) noted the similarity of these Aotea figures to those on the Otaki paepae in Whanganui Museum. Nevertheless, it must be noted that the differences in carving style and size probably indicate that this paepae and the Arapawaiti rauawa are not from the same pataka.

In summary, these stylistic correspondences suggest that the carver or carvers of these rauawa had close tribal relationship with the iwi of Te Ati Awa, Whanganui and Ngati Raukawa. Given the known tribal affiliations of the people living at Arapawaiti, these connections are to be expected, probably suggesting that the pataka was carved and built by local people.

In the 1850s, eight pataka situated at strategic places in the North Island were designated as Pillars of the Maori King Movement, termed Nga Pou o Te Kingitanga (Phillipps 1952:102–103). These are said to have stood at Taranaki, Otaki, Whanganui, Pito-one (Petone), Wairarapa, Waiohiki (Hawkes Bay), Taupo and Waikato, although some of these were possibly built for other previous reasons as well. This concept may also have been a metaphorical figure of speech, not actually referring to specific pataka at every locality.

Phillipps (1952:110) suggested that the Otaki paepae now in Whanganui Museum may have come from the Pillar of the King Movement situated at Otaki. However, given the extremely

large size of the Arapawaiti pataka, it is feasible that this may have been the pataka referred to as one of the Pillars of the King Movement. During this time in the 1850s and 1860s many of Ngati Raukawa at Otaki and Te Ati Awa at Waikanae were strong supporters of the Maori King Movement (Carkeek 1966:95–100). Certainly, the Arapawaiti pataka would have been the most prominent storehouse in these districts in its time.

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[SHORT NOTE]

ANOTHER MAORI BARKCLOTH BEATER FROM THE KAIPARA HARBOUR

ROGER NEICH

KEYWORDS: Barkcloth; aute; Maori; beater; Kaipara Harbour.

New Zealand Maori manufacture of barkcloth, aute, from the inner bark of the paper mulberry tree (*Broussonetia papyrifera*) is one of those Pacific-wide technologies that clearly demonstrate the Eastern Polynesian origins of the Maori. Aute barkcloth was still being made in New Zealand when Cook's expedition arrived here in 1769, following a process and technology that apparently had not changed over the previous several hundred years since its introduction by the first Polynesian settlers. However, soon after European settlement, the manufacture and use of aute barkcloth became obsolete. By the 1840s, the paper mulberry had become extinct through neglect of the plantations and the depredations of introduced cattle. All that have survived are some barkcloth beaters, some very doubtful examples of Maori barkcloth, some sketches by Cook's artists of Maori wearing small rolls of aute in their ears, and a corpus of Maori traditions and place names relating to the manufacture and use of aute.

A recent survey (Neich 1996) of all this evidence documented all the then known surviving Maori barkcloth beaters, fourteen in total, that have been found in swamps, lake beds, stream beds, estuarine gravels, and estuarine tidal mud flats. Only one of these was associated with a known archaeological site, from the bed of Lake Mangakaware in the vicinity of a prehistoric swamp fortification on the lakeshore. They are distributed across the northern parts of the North Island, with concentrations in Northland, Auckland and the Waikato. Two of these were found exposed in mud at low tide in the Wainonoro Creek, Whakaki River, leading into the Kaipara Harbour (Neich 1996:130–132). Now, another, fifteenth, Maori barkcloth beater has been found in the Kaipara Harbour area and is described below in the same format as those recorded previously (Neich 1996).

XV. Otamatea River, Kaipara Harbour (Fig. 1)

Locality: This beater was found on the west bank of the Otamatea River, Kaipara Harbour, upstream from Paparoa Point. The find spot is on Map NZMS 260, Sheet Q08, Maungaturoto (Edition 1, 1981) at grid reference 331558.

Repository: As an artefact registered under the Antiquities Act 1975, the repository of this beater is yet to be decided by the Crown.

Registration Number: Interim Auckland Museum Maori antiquity number N.318.

Provenance: Found by Richard Blackwood in October 1999 while walking along the bank of the Otamatea River. Richard spotted the beater by noticing the burnt end of the handle. It was lying with its grooved face downward on a dry bank. He believed it had been flushed out from higher up the river by recent rains which had washed it up on to the dry bank. There is much evidence of Maori occupation along the banks of this river (Mr Richard Blackwood, pers. comm., 2 May 2002).

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Fig.1. Maori barkcloth beater. Otamatea River, Kaipara Harbour.

Weight: 231.9 g.

Size: 33.4 cm long, 4.1 cm wide but longitudinal section split away. Beater portion 20 cm long.

Wood: Kauri branch heartwood. This is highly resinous, dense, reaction wood that resists rotting when the branch falls to the ground and the outer lighter wood decays. This leaves the dense resinous heartwood lying on the forest floor where it is readily available to be shaped into various forms of beaters (Dr Rod Wallace, pers. comm., 2 May 2002).

Description: A longitudinal section running the full length of the artefact has split away, leaving a slightly waterworn surface. One beating facet has longitudinal grooves, the other two surviving facets are smooth, and one facet has been completely split away. The light brown timber with long curving grain imparts a slight wavy curve to the whole artefact. The handle is roughly circular in cross-section, showing adze marks, with a taper to a blunt proximal point which is charred by fire. There is a pronounced shoulder between handle and beater portion on the side with the grooves, also on the surviving plain side but the side opposite the grooves has no shoulder between beater and handle. The beater portion has parallel sides with no evidence of expansion towards the distal end. In cross-section (Fig. 2), the beater portion is quadrangular with distinct edges to the surviving sides. Deep flat-topped longitudinal grooves at a gauge of three to four grooves per centimetre run the full length of the beater portion. The surface of the grooved facet is very smooth with a shiny patina. There is no obvious detritus in the grooves. The distal end is left rough revealing how the beater has been shaped from an off-centre portion of the branch which has subsequently split along one of the radial lines.

Discussion: Following the distinctive features identified for New Zealand barkcloth beaters (Neich 1996:139), this beater can be described as having a quadrangular cross-section, sharp shoulder, no butt enlargement, an overall parallel form, plain longitudinal grooves, only one facet grooved, and no variation in gauge of grooving. Its total length is close to the average of 29.5 cm established previously, while the beater facet constitutes 59.9% of this total length, again close to the previous average proportion. Therefore according to all these features, this beater fits comfortably within the range of most Maori barkcloth beaters. Following the typology established in Neich (1996:140, 142), it can be classified as a Type 1 beater, a type characteristic of Northland.

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Fig. 2. Maori barkcloth beater, distal end. Otamatea River, Kaipara Harbour.

In conclusion, the finding of this barkcloth beater provides no new surprising variations but does add another record to the available information and helps to confirm the validity of the typology previously established.

Acknowledgements. I thank Dr Nigel Prickett, Auckland Museum archaeologist for drawing this beater to my attention, Dr Rod Wallace, University of Auckland technical officer for identifying the wood, and Mr Richard Blackwood for his description of the finding.

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[SHORT NOTE]

AN UNUSUAL MAORI WAR CANOE PROW WITH EMBRACING FIGURES

ROGER NEICH

KEYWORDS: Maori; war canoe; embracing figures; Arawa; Rotorua.

An unusual Maori war canoe prow in the collection of the Hull Maritime Museum, Hull, England has recently been brought to my attention. The prow has been in the Hull Maritime Museum since 1951 when it was sent there from the Science Museum, South Kensington, London. It had been presented to the Science Museum, London in 1876 by R.H. Rhodes through S.H. Wright of French Gate, Doncaster (Letter, H.G. Lyons, Director of the Science Museum to H.E. Vaile of Auckland, 26 September 1923, Ethnology Department files, Auckland Museum). In 1923, the Director of the Science Museum also supplied a fine sketch of the prow with detailed measurements. In 1892 it had been displayed in the Liverpool Naval Exhibition. Further enquiries to the Science Museum, London have confirmed this information and noted the Science Museum registration number as 1876–1502.

This is a pitau type of war canoe prow (Figs 1, 2) painted red, with an overall length of 213.4 cm, height 71.1 cm, width 71.2 cm. In most respects it is a very large standard type of pitau prow with the usual forward-facing figure of stylised form and sweptback arms, central vane with pierced pitau or takarangi spirals separated by an openwork figure, transverse rear panel, and figure(s) facing into the canoe, all carved from one solid piece of timber. One of the arms of the front figure has been broken off and one of the figures behind the transverse board has lost its head. However, two features mark this prow as unusual. First are the extremely large yet delicate openwork takarangi spirals on the central vane, remarkable for their regularity and fine carving.

The second special feature, which makes this prow unique to my knowledge, is the replacement of the usual single figure, called a huaki, facing rearwards into the canoe by a pair of embracing figures with their bodies facing each other and their heads turned towards the stern of the canoe. The complete figure is carved in naturalistic style with incised female tattoo patterns on the forehead and sides of the nose. Unfortunately, the other figure, presumably male, has lost its head but the rest of the body survives. They embrace from a seated position with their legs crossed over each other and large naturalistic three fingered hands around the back of the opposite body. Also unlike most other canoe prow huaki figures, they have been carved almost free of the transverse panel, projecting up from the base and joined to the panel only at the back of the head. In describing a huaki “bulkhead” figure from the war canoe named Parehaki that belonged to Ngati Pikiao on Lake Rotoiti in 1853 (Neich 2001:20), the collector Gilbert Mair, who was fluent in Maori, called it a patutu, which might reflect a Ngati Pikiao dialectical variant term for such figures. The naturalistic style of this Ngati Pikiao huaki/patutu figure, which has also lost its head, is remarkably similar to the Hull Museum figures. It must be noted however, that Parehaki canoe may have been carved by Tuhourangi experts from Lake Tarawera.

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Fig. 1. Side view of the war canoe prow with embracing figures at the rear. Photo: Hull Maritime Museum.

In a recent survey of the occurrence of all known examples of this embracing figures motif (Neich 2001:280–285, 396–398), it was documented on one canoe paddle, on ancestor memorial palisade posts, gateways of fortified villages, exterior amo side posts of storehouses, doorways of storehouses, meeting house ridgepoles, meeting house door lintels, interior meeting house central ridgepole support posts, exterior amo side posts of meeting houses, and on small epa panels usually located below the window of a meeting house either on the porch back wall or inside the house. The canoe paddle is dated from 1834 and the other examples range through the middle and later nineteenth century. This survey revealed that this embracing figures motif was virtually confined to land-based architectural structures and is very characteristic of the Rotorua Arawa tribes. Most of the earlier examples of this motif up to about 1860 are by Ngati Whakaue with one or two by Ngati Pikiao. Ngati Pikiao continued to use it sparingly but it was taken up strongly by Ngati Tarawhai in the 1870s. Ngati Pikiao had ceased to use it by about 1890 but Ngati Tarawhai continued to develop and vary the motif considerably into the twentieth century.

As made clear by this survey, the embracing figures motif had not been documented previously on canoes and indeed was never expected in this context. Consequently, the canoe prow in Hull represents a surprising new record. Normally associated with ideas of fertility, the joining of descent lines, and political co-operation between descent groups, the reference for

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Fig. 2. Detail showing embracing figures, the female with facial tattoo marks. Photo: Hull Maritime Museum.

this motif in a war canoe is more problematic. The presence of a naturalistic female figure carved into a war canoe, which was customarily a strongly male domain, raises several other interesting questions. All indications are that the other figure, now missing its head, would have been a male. Out of the approximately 33 examples of embracing figures whose gender can be determined, four are male to male, the rest being male to female. There are none representing female to female.

On stylistic grounds, the carving of this prow can be probably attributed to Ngati Pikiao experts. In particular, the naturalistic body forms of the huaki figure, the form of the prone figure below the central vane, and the form and surface decoration of the face below the huaki figures, all suggest Ngati Pikiao carving style. Through the nineteenth century until the 1860s, many large war canoes were being produced by Ngati Pikiao experts with totara timber obtained from the forests around Lake Rotoiti and Lake Okataina (Neich 2001). However, apart from the prow figurehead and the huaki figure of Parehaki canoe, the two best-documented Ngati Pikiao canoe carvings are stern-posts (Neich 2001:164). The prow figurehead from Parehaki canoe is not very similar to the Hull figurehead and the stern-posts do not provide a shared form for comparison. Sadly, no other Ngati Pikiao surviving canoe carvings are now documented but many of the nineteenth century canoe carvings now held in museums must be their work.

Therefore, this note adds another attributed record to that corpus and documents the previously unrecorded carving composition of embracing figures featured on a war canoe prow.

Acknowledgements. I thank Hermione Waterfield of London and Les Jessop of the Hancock Museum, Newcastle for telling me about this prow. Peter Fitzgerald of the Science Museum, London supplied further information. Arthur Credland of the Hull Maritime Museum was especially helpful in answering my enquiries and supplying photographs.

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REVIEW OF FOSSIL HALIOTIDAE (GASTROPODA) FROM NEW ZEALAND WITH DESCRIPTION OF A NEW EARLY MIOCENE SPECIES

MICHAEL K. EAGLE

Abstract. Subgenera of *Haliotis* to which the Recent species are assigned are used in this review of the New Zealand fossil fauna. *H. matihetihensis* and *H. australis* are assigned to *Padollus*, and *H. virginea* and *H. flemingi* to *Paua*. A new species, *Haliotis (Marinauris) hokiangaensis* n. sp., is described from the early Miocene Otaua Group, Matihetihe, west Hokianga, Northland. Ten New Zealand fossil *Haliotis* species are allocated to six subgenera with few apparent lineages. Six New Zealand fossil haliotids are older than those presently known as fossils from Australia. The apparent incidence of New Zealand Cenozoic haliotids possessing shell characteristics of later Australian and South African taxa may be a result of convergent evolution in a local environment, but more likely a radiation eastwards from New Zealand in the late Oligocene onwards, when the circum-Antarctic Current began to flow. DNA inference in Recent New Zealand *Haliotis* suggests the possibility that in the late Palaeogene-early Neogene, New Zealand haliotids were a result of local radiation from either ancestral Tethyan or Panthalassian Ocean progenitors.

KEYWORDS: Haliotidae; Gastropoda; *Euhaliotis*; *Marinauris*; *Notohaliotis*; *Padollus*; *Paua*; *Sulculus*; new taxon; early Miocene; Pliocene; Otaian; New Zealand.

INTRODUCTION

Recent haliotids (Gastropoda: Haliotidae), commonly known as paua or abalone, are a commercial mollusc taken wild or aqua-cultivated for meat, pearl, and shell. Their economic value, environmental considerations, and fecundity have motivated research (e.g. Minh 1999). They are not common fossils, and research on fossil haliotids worldwide has been sporadic (e.g. Talmadge 1963, Dauphin *et al.* 1989, Pickery 1991, Lee & Vacquier 1995, Geiger 1999), with occasional overviews (e.g. Lindberg 1992, Geiger 1998a, Geiger & Groves 1999). There are isolated records of New Zealand fossil haliotids (e.g. Harris 1897, Suter 1913, Powell & Bartrum 1929, Fleming 1952, Carter 1972, Lee *et al.* 1983), with descriptions of New Zealand fossil haliotids being published by Powell (1938), Fleming (1952), Beu *et al.* (1990), and Eagle (1996, 1999).

Fossil record numbers are those of the New Zealand Fossil Record File and are prefixed by the appropriate NZMS 260 1: 50,000 map designation (e.g. R09). New Zealand fossil *Haliotis* types are held in the collections of Auckland War Memorial Museum (AK) and the Institute of Geological and Nuclear Sciences, Lower Hutt (GS). A possible new species of haliotid is held by the Geology Department, University of Otago (OU).

TAXONOMY

DNA research confirms the Haliotidae to be monophyletic (Lee & Vacquier 1995, Geiger 1999). As with most fossils, specimen preservation affects identification of haliotid taxa. The fragile, aragonitic, auriform haliotid shells are often shattered by strong currents and wave action, especially given the hard bottom, high-energy environment in which they live. Rocky shore facies and their fossils are rarely preserved because of this high-energy regime (Beu *et al.* 1990, Eagle *et al.* 1995, Eagle 1999). A poor fossil record results (Powell 1938, Beu *et al.* 1990, Eagle 1999). Haliotids usually delaminate or are crushed during sediment deposition and compaction (Eagle 1999), or (particularly in middle Cenozoic or older specimens) may be preserved as internal/external moulds with no or only partial shell details. Populations of Recent haliotid species are morphologically variable, and fossil populations probably also were (Geiger & Groves 1999).

In extant *Haliotis* species, shell characteristics can be modified by ontogeny, environmental controls, or hybridisation. Epipodia (Owen *et al.* 1971) and radulae (Herbert 1990) have been used for additional character sets in Recent species, but these are lost in fossils. Whereas sound taxonomy results from the availability of many specimens in the Recent, most New Zealand fossil haliotids are described from one specimen (e.g. Powell 1938, Fleming 1952). Recent haliotids have been classified by biological means, such as inferences from cDNA sequences of sperm lysin (e.g. Lee & Vacquier 1992, 1995; Geiger 1999). Nomenclature in this paper follows that of Knight *et al.* (1960), Beu *et al.* (1990), Eagle (1996, 1999) and Geiger & Groves (1999).

SYSTEMATICS

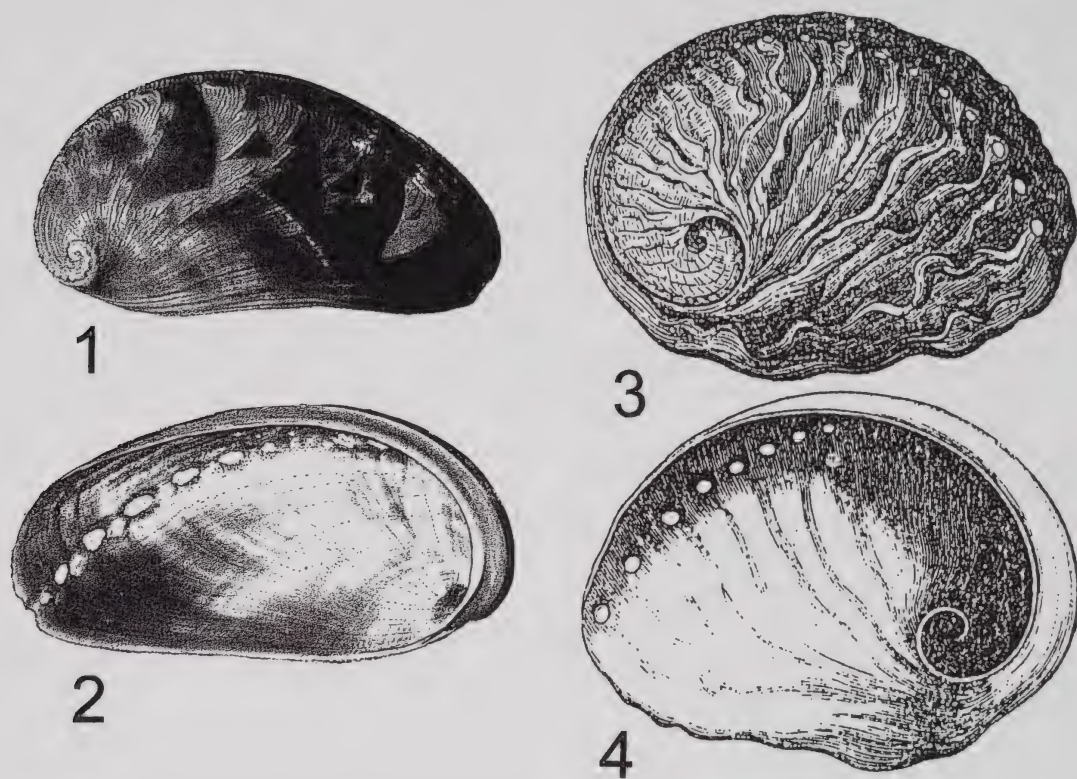
| | |
|---------------|---|
| CLASS: | GASTROPODA Cuvier, 1797 |
| SUBCLASS: | ORTHOASTROPODA Ponder & Lindberg, 1996 |
| SUPERORDER: | VETIGASTROPODA Salvini-Plawen, 1980 |
| ORDER: | ARCHAEOGASTROPODA Thiele, 1925 |
| SUBORDER: | PLEUROMARIINA Cox & Knight, 1960 |
| SUPERFAMILY: | PLEUROTOMARIACEA Swainson, 1840 |
| FAMILY: | HALIOTIDAE Rafinesque, 1815 |
| GENUS: | <i>Haliotis</i> Linnaeus, 1758 |
| Type species: | <i>Haliotis asinina</i> Linnaeus, 1758 (by subsequent designation, Denys de Monfort, 1810, Conch. Syst. 2, p.119, under L'Haliotide; Recent, Indo-Pacific). |

RANGE

Late Cretaceous (Maastrichtian) – Recent.

DIAGNOSIS

Shell auriform, asymmetrical, with low or raised spire situated more or less off-centre or sub-centre posteriorly; columella forming a wide flat or concave ramp around left side joining basal lip, sometimes with flange; spiral row of closed and open exhalant respiratory tremata along left side; no operculum.



Figs 1–4. 1–2. Recent *Haliotis* (*Haliotis*) *asinina*. Length 100 mm. 1. Dorsal. 2. Ventral. 3–4. Recent *Haliotis* (*Padollus*) *midae* (after Van Nostrand 1956). Length 95 mm. 3. Dorsal. 4. Ventral.

COMMENTS

Knight *et al.* (1960) recognised 11 subgenera in *Haliotis*; 13 subgenera were recognised by Vaught (1989). However, these have been significantly reduced in number among Recent species as a result of DNA research (Hara & Fujio 1992, Brown 1993, Lee & Vacquier 1995). The shell of *Haliotis asinina* (Figs 1, 2) is elongate and narrow, with an eccentric apex. Being an atypical species, no other species are assignable to the nominate subgenus.

SUBGENUS: *Euhaliotis* Wenz, 1938

Type species: *Haliotis midae* Linnaeus, 1758 (by original description; = *elatio*r Pilsbry, 1890; *capensis* Dunker, 1841). Recent, South Africa, South America.

New Zealand species: *H. mathesonensis* Eagle, 1996.

DIAGNOSIS

See Eagle (1996).

COMMENTS

H. (Euhaliotis) mathesonensis Eagle, 1996 is very large (diameter 170 mm; width 141 mm). The South African Pleistocene to Recent *H. (Padollus; emend Lee & Vacquier 1995) midae*

(Figs 3, 4) is morphologically the most similar haliotid to *H. (E.) mathesonensis*. *H. (P.) midae* is distinguished from *H. (E.) mathesonensis* by corrugations running obliquely to those of the growth lines, by being more ovate than elongate-ovate and by having a low spiral apex situated sub-centrally a quarter of the way along the specimen. For palaeo-ecology see Eagle *et al.* (1999).

Haliotis (Euhaliotis) mathesonensis Eagle, 1996

See Eagle (1996) for the description and illustrations of this Early Otaian (Burdigalian) fossil from the Cape Rodney Formation at Matheson's Bay, north Auckland. The holotype (AK72925) is the only specimen known.

DESCRIPTION

See Eagle (1996).

SUBGENUS: *Marinauris* Iredale, 1927

Type species: *Marinauris melculus* Iredale, 1927 (by subsequent designation, Wenz, 1938). Recent, Indo-Pacific, Queensland.

New Zealand species: *H. hokiangaensis* n. sp.

DIAGNOSIS

See Eagle (1999).

COMMENTS

Haliotis (Marinauris) melculus (Iredale, 1927) (Fig. 5) was synonymised with *H. (M.) brazieri* (Geiger 1998b) (Fig. 6). *H. (M.) brazieri* is ovate with an elevated spire. The upper surface of *H. (M.) brazieri* has a raised central spiral area and the sutural ramp is sculptured with numerous narrow, flat-topped, spiral ribs of irregular size, crossed by sharp, crescentic, transverse ridges with transverse striae in the interspaces. The tremata are large and oval, on slightly elevated tubercles, and normally six are open. *H. (M.) brazieri* has latera with a sharp-edged peripheral rib, concave below with about six roughly nodulose ribs. The shell is small (4 cm) compared with most haliotids.



Figs 5–6. 5. Recent *Haliotis (Marinauris) melculus*. Length 7 mm. Dorsal. 6. Recent *Haliotis (Marinauris) brazieri*. Length 30 mm. Dorsal.

Haliotis (Marinauris) hokiangaensis n. sp.

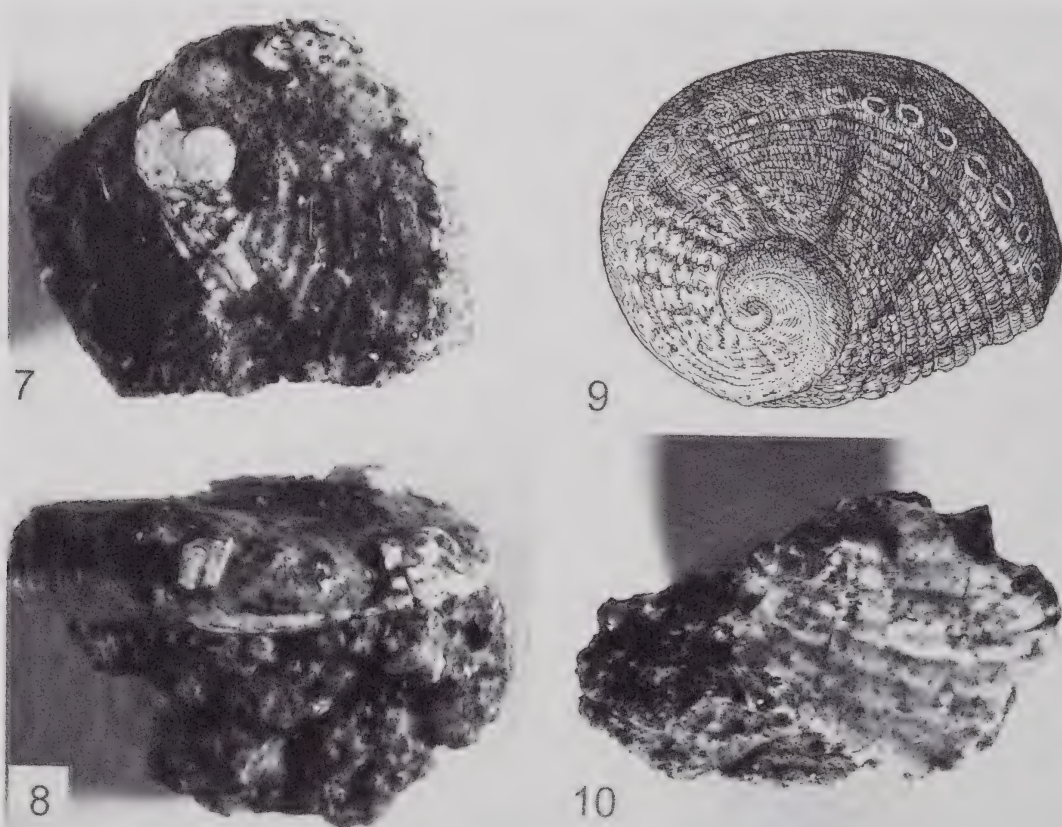
(Figs 7–10)

MATERIAL

Holotype. AK73252; specimen filled with sandstone matrix with parts of shell separated from steinkern; portion of apertural lip missing.

TYPE LOCALITY

Waititi Formation (Ballance *et al.* 1978), Otaua Group, O05/f143 grid reference O05/367403; cutting on south side of Matihetihe Road opposite Tangata Whenua Marae, adjacent to the Maori cemetery, near beach access, Matihetihe, north-west Hokianga, Northland. The fossil locality (Fig. 11) is part of a highly fossiliferous volcanoclastic mass flow deposit, now eroded to an isolated remnant. Irregular bands of siltstone (10–15 mm thick) and sandstone (30–50 mm thick) contain occasional carbonaceous fragments and shell hash. The interbedded sandstone contains a mixture of whole and partial (mostly decalcified) molluscs, solitary corals, and annelids.



Figs 7–10. Digital images and schematic reconstruction of the holotype of *Haliotis (Marinauris) hokiangaensis* n. sp. (AK73252). Length 17.6 mm. 7. Dorsal. 8. Anterior. 9. Reconstruction. 10. Shell interior showing radial cord arrangement on a portion of the sutural ramp.

AGE
Otaian (Aquitanian), Early Miocene (Ballance *et al.* 1978).

ETYMOLOGY
Named after the geographical area of Hokianga.

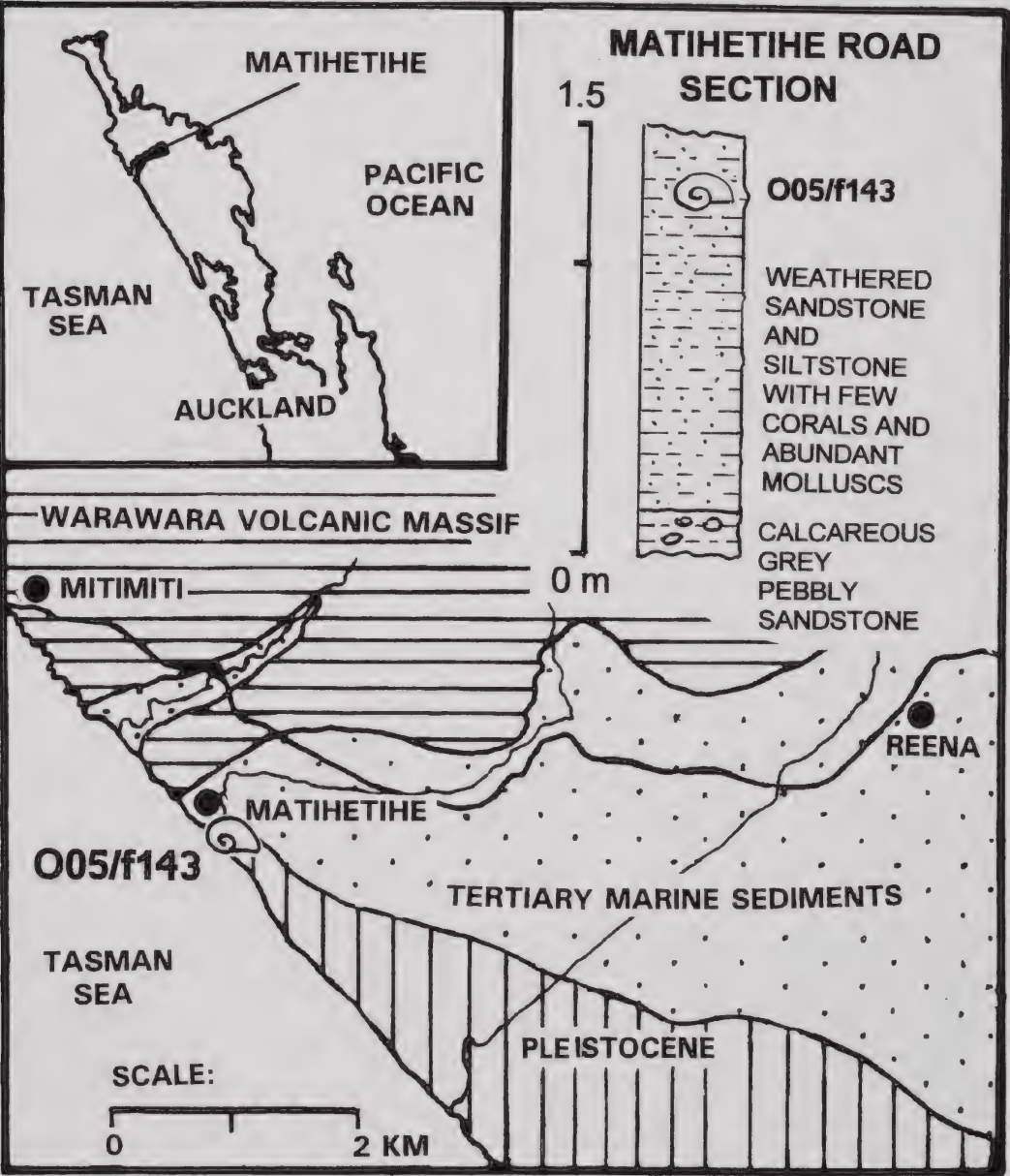


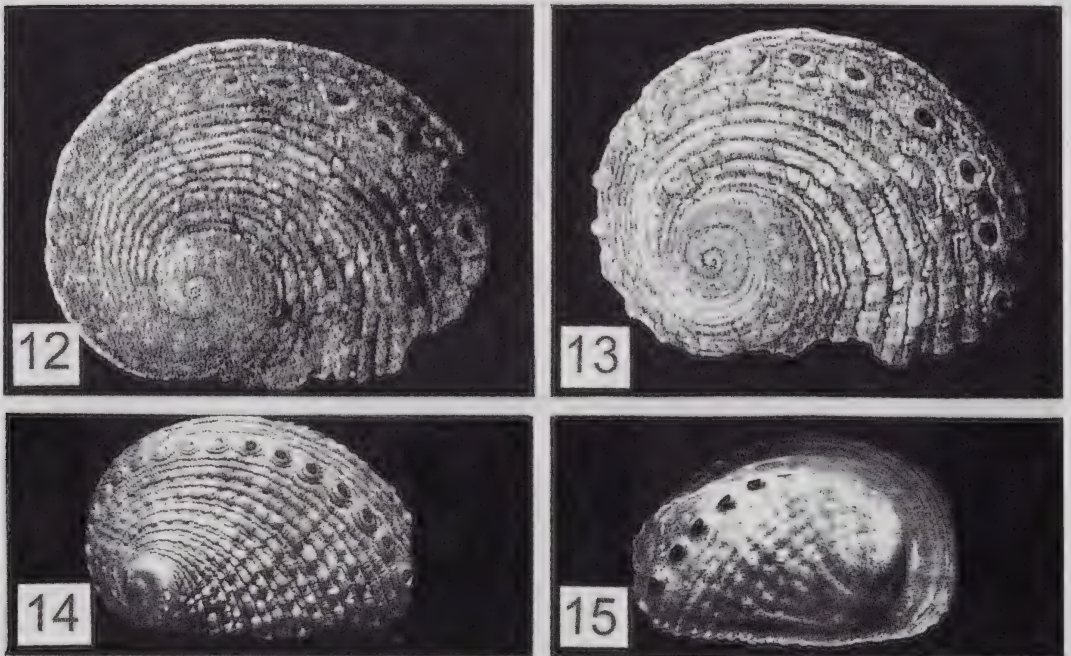
Fig. 11. Location map and stratigraphic column of the Matihetihe road cutting, Northland, New Zealand, showing details of the early Miocene fossil type locality O05/f143.

DESCRIPTION

Shell small, roundly ovate; conspicuous posterior spire, elevated above sutural ramp whorl; teleconch of $1\frac{1}{2}$ whorls, broad, almost flat, last whorl within submarginal apex; spire apex not strongly eccentric; protoconch rounded; dorsal shell spiral ornament with nine strong, subequal, smooth, rounded cords; spiral cords transversely nodulose, crossed by very fine striae, and with shallow, rounded grooves between; narrow irregular radial growth folds; tremata low, conical, small, subcircular orifices with thick, rounded borders; at least four tremata open, 21 on last whorl separating upper whorl surface from outer face; outer face convex with three thick, sharp, unequal spiral cords with deep, narrow, correspondingly unequal grooves; central cord forming a subdued medial keel; anterior lip, labial area unknown. DIMENSIONS: Diameter 17.6 mm, width 11.8 mm, height 4.1 mm.

REMARKS

The small shell size suggests a juvenile, although species in this subgenus do tend to be small. The ovate-circular shell outline, flattened sutural ramp with slightly elevated subcentral spire, sculpture of well-developed spiral cords with axial folds, and low, conical tremata, confirm assignment of *Haliotis hokiangaensis* to the subgenus *Marinauris*. Because part of the penultimate whorl and apertural lip are missing, comparison cannot be made with other species on the basis of the number of open tremata. The most similar in shell morphology to *Haliotis* (M.) *hokiangaensis* are the species *H. (M.) ethologus* Iredale, 1927 (Fig. 12); *H. (M.) hargravesi* Cox, 1869 (Fig. 13); *H. (M.) brazieri* Angas, 1869 (Fig. 6); *H. (Sanhaliotis) crebrisculpta* Sowerby,



Figs 12–15. 12. Recent *Haliotis* (*Marinauris*) *ethologus*. Length 7 mm. Dorsal. 13. Recent *Haliotis* (*Marinauris*) *hargravesi*. Length 31 mm. Dorsal. 14–15. Lectotype of Recent *Haliotis* (*Sanhaliotis*) *crebrisculpta* (from Geiger 1998b). Length 30 mm. 14. Dorsal. 15. Ventral.

1914 (Figs 14, 15); *H. (Padollus) roei* Gray, 1827 (subgenus emended Lee & Vacquier 1995) (Figs 16, 17); and *H. (M.) queketti* E. A. Smith, 1910 (Fig. 18).

Geiger (1998a) suggested that *H. (M.) ethologus* from southern Queensland is actually a northern Australian form of the more southern species *H. hargravesi*, and that *H. melculus*, similarly, is the southern *H. brazieri*. He comments that *H. hargravesi* shows extensive intraspecific variations, and that intergrades (i.e. potential hybrids) between these variations and *H. brazieri* exist where the ranges of the two species overlap. The four nominal species are collectively regarded by Geiger (1998a) as the '*hargravesi-brazieri* continuum'.

Stewart & Geiger (1999) ascertained that the three syntypes of *H. crebrisculpta* Sowerby, 1914 were of two different species. One is clearly the shell figured by Sowerby in his original description and is designated by Stewart & Geiger (1999) as the lectotype of *H. crebrisculpta*; the other two specimens are identical with the type of *H. (Sulculus) clathrata* Reeve, 1846 distributed widely in the western Pacific but not considered similar enough for comparison with *H. (M.) hokiangaensis*.

H. (M.) hokiangaensis differs from the small (4 cm) Recent southern Queensland and northern New South Wales species *H. (M.) hargravesi* by having only nine instead of 11 evenly spaced transversely nodulose spiral ribs that are elevated and broadly rounded, not narrow and flat-topped as in *H. (M.) hargravesi*. Although the outer sides of *H. (M.) hokiangaensis* and *H. (M.) hargravesi* are both convex, *H. (M.) hokiangaensis* has only three thick, sharp, unequal radial cords, whereas *H. (M.) hargravesi* possesses four equal radial cords. The small (3 cm) southern Queensland to New South Wales species *H. (M.) brazieri* is more circular than *H. (M.) hokiangaensis* and on the sutural ramp has a broad, smooth central spiral rib bordered by a few incised spiral lines either side, instead of the nine evenly-spaced, broadly rounded, transversely nodulose spiral ribs of *H. (M.) hokiangaensis*. *H. (M.) hokiangaensis* also differs from *H. (M.) brazieri* in having, on the outer side of the shell, three thick, sharp, unequal radial cords, not the three faint ribs in the upper area, and three angular ribs on the bottom showing on the outer shell side of *H. (M.) brazieri*.

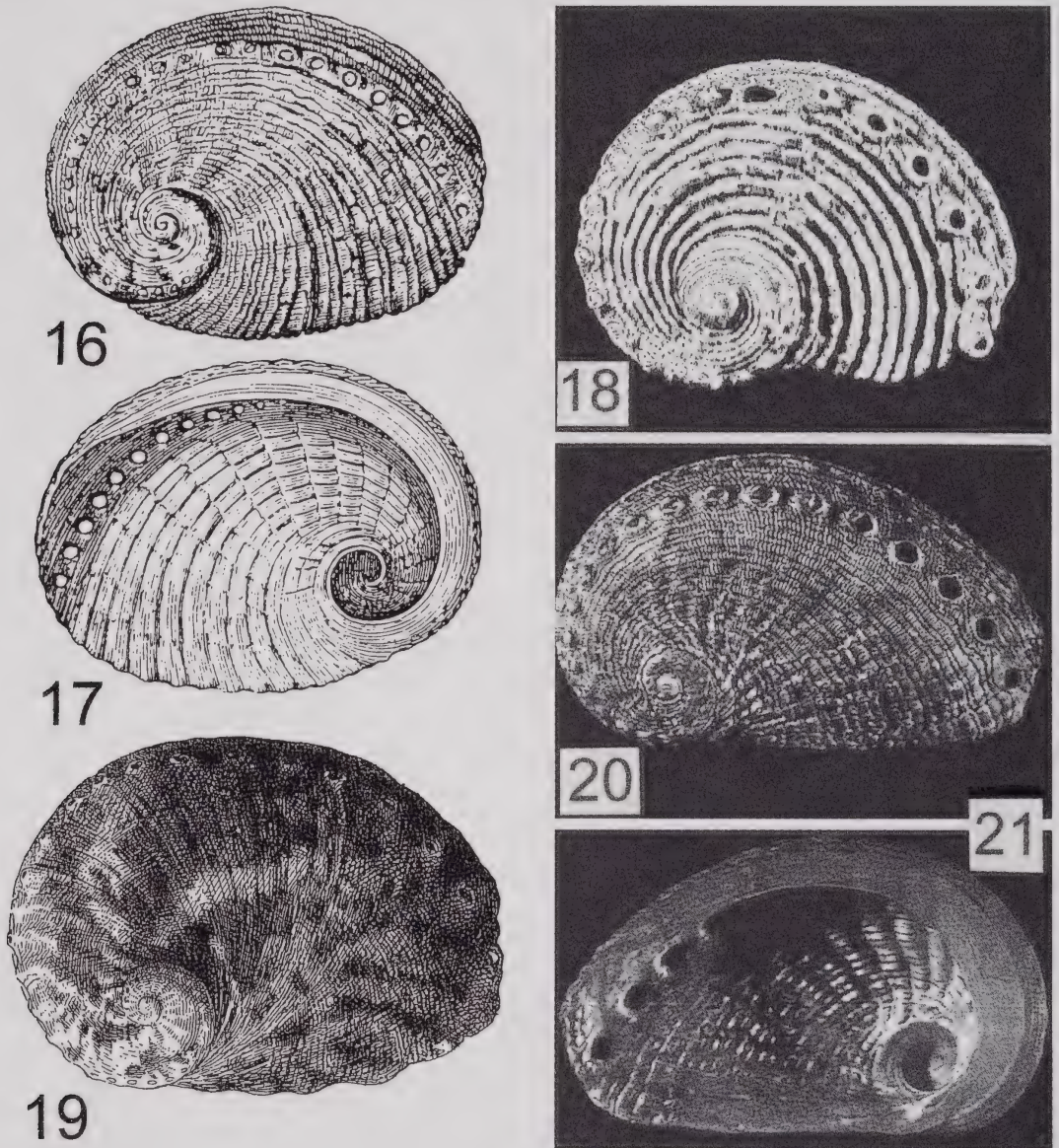
Recent *H. (Sanhaliotis) crebrisculpta*, known only from New Caledonia, differs from *H. (M.) hokiangaensis* by being more elongate-ovate, having 17 rounded and transversely nodulose unequal spiral cords, and an outer side with five sharp cords instead of the three of *H. (M.) hokiangaensis*. The Recent medium-sized (12 cm) Western Australian species *H. (Padollus) roei* differs from *H. (M.) hokiangaensis* in having 14 knotted, rough spiral cords of variable width also crossed by prominent growth folds and a slightly higher spire. Unlike *H. (M.) hokiangaensis*, the rare South African Recent species *H. (M.) queketti* has seven equal, rounded spiral cords on the sutural ramp, tremata with round apertures and thicker borders, and only two sharply defined spiral ribs of equal thickness on outer side of shell.

The conspicuous spire posteriorly elevated above the sutural ramp whorl, the broad, almost flat, last whorl within submarginal apex, the dorsal spiral ornament of nine strong, equal, smooth transversely nodulose rounded cords, crossed by very fine striae with shallow rounded grooves between, and the outer concave face with three thick, sharp, unequal radial cords (the central cord forming a subdued medial keel), differentiate *H. (M.) hokiangaensis* from other fossil or Recent haliotids.

SUBGENUS: *Notohaliotis* Cotton & Godfrey, 1933

Type species: *Haliotis naevosa* Martyn, 1784 (by original designation; not binomial; = *ruber* Leach (Fig. 11), 1814; *tubifera* Lamarck, 1822; *gigantea* Peron, 1816). Australia.

New Zealand species: *Haliotis* sp.; *H. waitemataensis* Powell, 1938.



Figs 16–21. 16–17. Recent *Haliotis (Marinauris) roei* (after Van Nostrand 1956). Length 81 mm. 16. Dorsal. 17. Ventral. 18. Dorsal view of Recent *Haliotis (Marinauris) queketti*. Length 29 mm. 19. Dorsal view of Recent *Haliotis (Padollus) ruber* (from MacPherson & Gabriel 1962). Length 79 mm. 20–21. Recent *Haliotis (Notohaliotis) clathrata* (from Geiger 1998b). Length 29 mm. 20. Dorsal. 21. Ventral.

DIAGNOSIS

Tremata on tubular projections situated on angulation separating upper whorl surface from flat or concave outer face; ornament spiral cords, threads crossed by irregular transverse ribs oblique to collabral lines (Knight *et al.* 1960). No raised or prominent dorsal rib.

COMMENTS

Recent *Haliotis* (*Padollus*) *ruber* Leach, 1814 (subgenus emended Lee & Vacquier 1995) (Fig. 19), from New South Wales to South Australia and Tasmania, is ovate with a rounded dorsal surface and a low spire; it has broad radial folds crossed by many fine, beaded spiral cords on the sutural ramp, and 6–7 open tremata of conical tubercles with a spiral concave area between these and the margin. *H. (Notohaliotis)* *clathrata* Reeve, 1846 (Figs 20, 21) “. . . from Queensland has a small, depressed, almost circular shell and may be a variant of *H. (P.) ruber* . . .” (Wilson *et al.* 1993: 50).

***Haliotis (Notohaliotis) waitemataensis* Powell, 1938**

(Figs 22, 23)

TYPE LOCALITY

Bostaquet Member, Cape Rodney Formation, Kawau Subgroup (Hayward & Brook 1984), basal Waitemata Group (Ballance 1974), Akarana Supergroup (Ballance *et al.* 1978); in sandy limestone, Fossil Point, east side of Bostaquet Bay, Kawau Island.



Figs 22–24. 22–23. Holotype of *Haliotis (Notohaliotis) waitemataensis* (AK72068). Length 56 mm. 22. Dorsal. 23. Posterior. 24. Dorsal view of *Haliotis (Padollus) scalaris emmae* (from MacPherson & Gabriel 1962). Length 58 mm.



MATERIAL

Holotype. AK72068, complete specimen with some adherent matrix.

AGE

Early Otaian (Burgidalian), Early Miocene (Powell 1979, Eagle *et al.* 1994).

DESCRIPTION

Shell moderate size, ovate depressed; sculpture of imbricating strong radial folds crossed by spiral cords of three sizes; penultimate whorl of five well-defined, equispaced cords which increase in strength anteriorly, cover body-whorl; intermediate cords commence after first post-nuclear whorl, interspaces between main ribs with subsidiary median rib and finer rib either side also separated by interspaces; main spiral ribs 5 mm apart, radials likewise at middle of body-whorl; lower margin of shell keel spirally ribbed (number unknown due to matrix covering); protoconch worn, $\frac{1}{3}$ of length from left margin, less than $\frac{1}{3}$ width from front margin; tremata distinctly raised, tubular, numbering about 21 on body-whorl, five open. DIMENSIONS: Length 56 mm, width 46 mm, height (estimated) 17 mm.

REMARKS

Powell (1938: 377) considered *Haliotis* (*Notohaliotis*) *waitemataensis* to be undoubtedly of that subgenus, whilst declining to allocate a subgenus to *H. flemingi* described in the same paper on the same page. Geiger & Groves (1999) thought the Oligocene *Haliotis* sp. of Beu *et al.* (1990) similar to *H. (Notohaliotis) waitemataensis*, with a strong resemblance to the Recent Australian species *H. (Padollus) scalaris emmae* Reeve, 1846 (Fig. 24). Whilst the shell outline and growth folds of *scalaris emmae* are similar, fewer spiral cords on the sutural ramp and scales developed at intersections of the spiral cords with axial plicae differentiate *H. (Notohaliotis?)* sp. from *H. (P.) scalaris emmae*. Irrespective of shell form, DNA investigation of the *Notohaliotis* type, *H. ruber* indicates assignment to *Padollus* (Lee & Vacquier 1995). This example illustrates the difficulty in assigning subgenera originally erected to classify Recent species on the basis of shell morphology, to fossil species.

***Haliotis* (*Notohaliotis?*) sp.**

MATERIAL

See Beu *et al.* (1990) for the description and illustrations of this Duntroonian or Waitakian, late Oligocene (Chattian) fossil from the Cookson Volcanics at a road cutting on the Inland Kaikoura Road near "The Whaleback", North Canterbury. Several specimens are known, including GS9883.

REMARKS

Beu *et al.* (1990: 154) described this specimen (without naming it), commenting "the new species is apparently closely related to *H. (Notohaliotis) waitemataensis* (Otaian, Kawau Island [Figs 22–23]), but differs in having fewer spiral cords on the sutural ramp, and in having spines or scales developed at intersections of spiral cords with axial plicae". They considered that "the subcentral apex, the prominent spiral and scaly sculpture and the large tremata differentiate this species from other New Zealand haliotids".

SUBGENUS: *Padollus* Montfort, 1810

Type species: *H. scalaris* Leach, 1814 (= *H. rubicundus* Gray, 1826 [non *Haliotis rubicunda* Roding, 1798]; = *tricastalis* Menke, 1843; = *Neohaliotis* Cotton & Godfrey, 1933). Australia, Indo-Pacific, South Africa.

New Zealand species: *H. matihetihensis* Eagle, 1999, *H. australis* Gmelin, 1791.

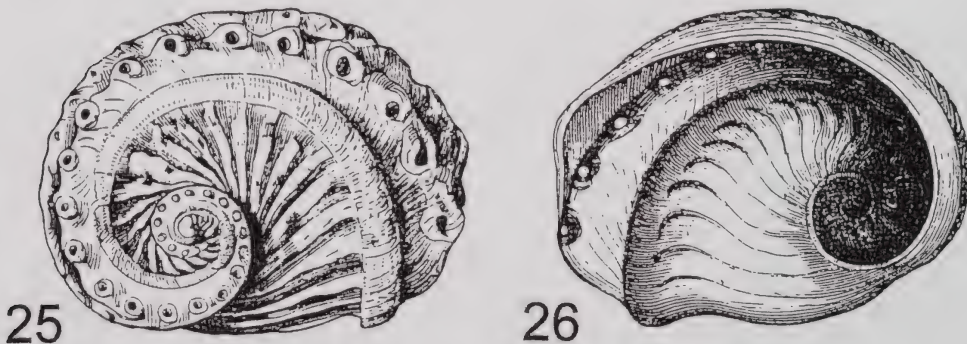
DIAGNOSIS

Broad spiral rib sometimes with prominent thin collabral lamellae on abapical side, or spiral striae sometimes crossed by irregular transverse ridges or nodes; tremata on low tubular projections at angulation separating upper whorl surface from concave outer face, commonly without frilly projections near periphery.

COMMENTS

H. (Padollus) scalaris (Figs 25, 26), a common Recent Western Australian species, is an ovate, thin-shelled haliotid with a moderately elevated spire. It is complexly sculptured with a thick central rib itself having scaly spiral cords, and it possesses thin, obliquely-inclined radial lamellae between the rib and the spire. The outer side of *H. (P.) scalaris* has a deep furrow between tremata of conical tubercles with moderately sized apertures (4–6 open) and a roughly nodulose marginal rib. Wilson *et al.* (1993: 50) considered *H. (P.) scalaris* and *H. (P.) emmae* (Fig. 24) to be "... obviously related. Specimens of *H. emmae* from western South Australia are intermediate in sculpture". This form of *H. (P.) scalaris* has since been synonymised with *H. (P.) emmae*, the latter becoming the subspecies *H. (P.) scalaris emmae* (e.g. Geiger 1999).

H. australis and *H. virginea* were assigned by conchologists on the basis of shell morphology to *Sulculus* (e.g. Powell 1979). However, *Sulculus* was originally diagnosed as a subgenus of *Padollus* and synonymised with the latter by most reviewers (e.g. Fleming 1952). Spencer & Willan (1995) in their review of New Zealand Mollusca continued to assign *H. australis* and *H. virginea* to *Sulculus*. Lee & Vacquier (1995) assigned the living New Zealand species *australis* to *Padollus* and *virginia* to *Paua*, replacing *Sulculus*. *H. matihetihensis* was incorrectly assigned by Eagle (1999) to the subgenus *Marinauris*; the juvenile specimen has a worn, raised, broadly rounded, prominent dorsal rib on the abapical side of the tremata with an apparently corresponding groove on the interior of the shell that are diagnostic of *Padollus*.



Figs 25–26. *Haliotis (Padollus) scalaris scalaris* (after Van Nostrand 1956). Length 66 mm. 25. Dorsal. 26. Ventral.

Haliotis (Padollus) matihetihensis Eagle, 1999

See Eagle (1999) for the description and illustrations of this Otaian (Aquitanian) fossil from the Waititi Formation, Otaua Group, north-west Hokianga, Northland. The holotype (AK73135) is the only specimen known.

REMARKS

Padollus is a more appropriate subgeneric assignment for *H. matihetihensis* because the shell is roundly ovate, the apex is not strongly eccentric, and a broad rounded spiral rib is prominent on the abapical side of the tremata. The tremata of *H. (Padollus) matihetihensis* are proportionately large on tubular, conical projections on (not 'adjacent to' as in the original description) a subdued second rib. The small size of the unique specimen suggests a juvenile, but the number of tremata and a reconstructed basal flange and apertural lip, suggest a sub-adult or adult specimen.

Haliotis (Padollus) australis Gmelin, 1791

(Figs 27, 28)

MATERIAL

GS15119, R28/f62, Cape Turakirae, Wellington (few fragments; 1855 uplift); GS12254, CH/f532, Okawa Point Formation, Owenga, Chatham Islands. (List provided by A. Beu, 23 April 2002.)

AGE

Holocene – Recent.

DESCRIPTION

Medium sized elongate-ovate *Haliotis*; spire of $2\frac{1}{2}$ whorls, elevated above sutural ramp; surface ornament of 10–15 densely spaced spiral striae of similar thickness and strength crossed by rough, irregular, transverse corrugations; tremata low, prominent, with orifices subcircular, usually 7–8 open; outer face with three prominent spiral ribs; rounded instead of flanged columellar margin; pale silver nacreous interior. DIMENSIONS: Length 107 mm, width 73 mm (average specimen).

REMARKS

A phylogenetic tree based on lysin cDNA by Lee & Vacquier (1995) grouped extant *H. australis* with the Australian Recent species *H. varia*, *H. ovina*, and *H. diversicolor* in the subgenus *Padollus*. The short, late fossil record suggests a moderately young species that has locally radiated sometime in the Pliocene-Pleistocene, possibly (by DNA inference) from Australian stock.

SUBGENUS: *Paua* Fleming, 1952

Type species: *Haliotis iris* Gmelin, 1791 (p. 3691; by subsequent description). New Zealand.

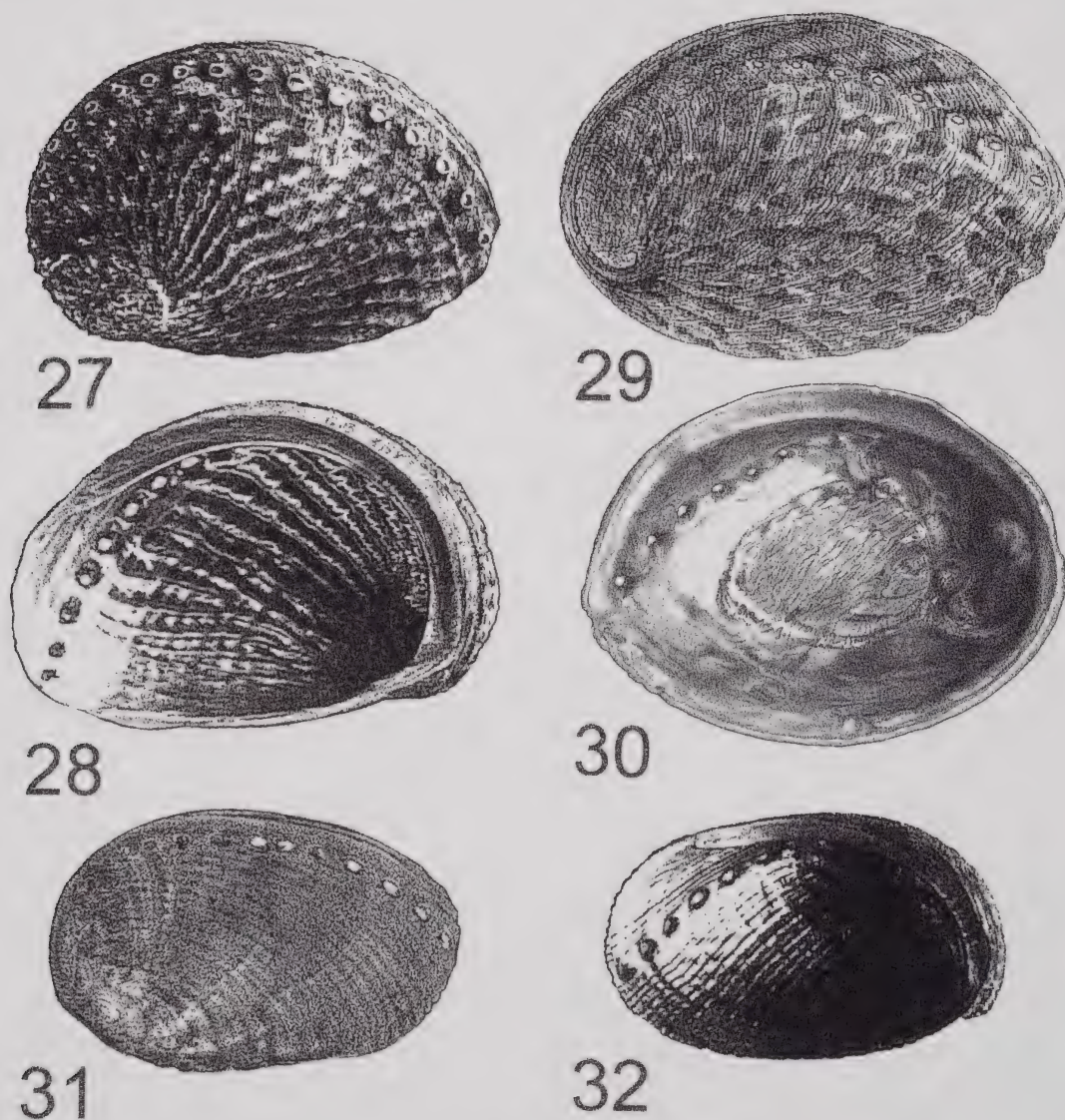
New Zealand species: *H. iris* Gmelin, 1791; *H. virginea* Gmelin, 1791; *H. flemingi* Powell, 1938.

DIAGNOSIS

Shell very large and solid, broadly ovate in outline with a wide, flat columellar flange continued below spire, meeting outer lip; whorls very rapidly increasing, profile slopes outward to columellar flange, forming periphery; spire filled with callus.

COMMENTS

The subgenus was erected by Fleming (1952) specifically to accommodate the shell morphology of *H. iris*. The phylogeny of lysin cDNA (Lee & Vacquier 1995) supports *Paua* as a valid subgenus.



Figs. 27–32. 27–28. *Haliotis (Padollus) australis*. Length 53 mm. 27. Dorsal. 28. Ventral. 29–30. *Haliotis (Paua) iris* (from Suter 1913). Length 102 mm. 29. Dorsal. 30. Ventral. 31–32. *Haliotis (Paua) virginea*. Length 41 mm. 31. Dorsal. 32. Ventral.

***Haliotis (Paua) iris* Gmelin, 1791**

(Figs 29, 30)

MATERIAL

GS996, R13/f6009, Kaawa Creek, Waikato (Opoitian; single complete shell). GS12482, U21/f10, Jumped-up Stream, Mangleton Road, inland central Hawke's Bay (Mangapanian; single incomplete shell). GS12681, E38/f19, Teer Formation, north coast Cascade Point, South Westland (Castlecliffian; fragments). GS1512, Y19/f9499, "raised beach" Te Mahanga, Mahia Peninsula (Holocene; single complete shell). GS15080, Y19/f65, marine terrace, Table Cape, Mahia Peninsula (Holocene; single small complete shell). GS6481, W21/f8556, GS13937, W21/f58, terrace in front of shelter hut, Cape Kidnappers (Holocene – 2.5 ka; small complete shells and fragments). GS15119, R28/f62, GS15121, R28/f72, Cape Turakirae, Wellington (Holocene – 1885 uplift; abundant complete shells). (List provided by A. Beu, 23 April 2002.)

AGE

Opoitian – Recent.

DESCRIPTION

Shell very large, thick, broadly-ovate; spire low, posteriorly fused with columella border with deep furrow between spire and border; teleconch of about $1\frac{1}{2}$ whorls, whorls very rapidly increasing; sutural ramp convex, sides rounded, sloping; basal columellar flange substantial, wide; spiral sculpture of broad spiral ribs at lower margin crossed by fine, axial growth ridges; tremata moderate-sized, low, nearly circular, apertures 3–4 mm diameter, 6–7 open, sited on angulation of dorsal margin; iridescent, nacreous interior; green-brown exterior. DIMENSIONS: Length 170 mm, width 128 mm, height 55 mm.

REMARKS

DNA inference suggests that *H. (Paua) iris* is a long-ranging taxon (Lee & Vacquier 1995), yet the species is known only from the Pliocene onward (A. Beu pers. comm., 23 April 2002). Migration, past climate/sea changes, lack of suitable facies, and preservation constraints may have all contributed to the brevity of the species in the New Zealand fossil record.

***Haliotis (Paua) virginea* Gmelin, 1791**

(Figs 31, 32)

MATERIAL

GS9323, O32/f8615, North Canterbury coast, stream south of Medina River, south of Conway (Nukumaruan). GS15037, T24/f127, shelly conglomerate, stream north of Saddle Road, north of Manawatu Gorge (Nukumaruan; single incomplete shell). GS12293, E38/f13, Teer Formation, north coast of Cascade Point, South Westland (Castlecliffian; shell fragments). GS4174, Q22/f7464, Oturi Shellbed, "Waipipi Beach", mouth of Wairoa Stream, Waverley Beach, west of Wanganui (Haweran – oxygen isotope 5c; single specimen). GS689, Y19/f9491, "raised beach" north shore Mahia Peninsula (Holocene). (List provided by A. Beu, 23 April 2002.)

AGE

Nukumaruan – Recent.

DESCRIPTION

Shell small, narrowly ovate; spire in adults enucleated in overall shape, prominent towards external lip; dense but rather weak external sculpture of narrow striae, crossed on the early whorls only, by weak axial corrugations, themselves forming weakly beaded striae; ornamentation extends beyond suture line onto upper outer face above columellar border; columellar border has slight furrow along entire length; interior highly iridescent, nacreous; exterior light brown, variegated with green.

REMARKS

Based on sperm lysin cDNA Lee & Vacquier (1995) suggested that *H. virginea* was a plausible inclusion with *H. iris* in the subgenus *Paua*. *H. (Paua) virginea* does not fit well with Fleming's (1952) diagnosis of *Paua. H. (P.) virginea*, is a much smaller, shorter, thinner shelled, and more inflated species than *H. (P.) iris*. However, *H. (P.) virginea* is as proportionately 'robust' as *H. (P.) iris*, is broadly ovate in outline, and has a flat columellar flange continued below the spire meeting the outer lip. Whorls of *H. (P.) virginea* do not increase as rapidly as those in *H. (P.) iris*, the spire is not as callused, and the shell profile does not slope outward to the columellar flange to the same degree. Fleming (1952) acknowledged the discrepant coiling in *H. (P.) virginea*. Range and exposure of *H. (P.) virginea* and *H. (P.) iris* are similar, but the latter's sub-littoral habitat, beneath shoreline boulders and on clean shell hash or gravel, is a more open environment. *H. (P.) virginea* and *H. (P.) iris* have different feeding niches. The larger and more abundant species lives mostly under ledges, in channels, and within sub-tidal caverns. *H. (P.) virginea* appears resident in New Zealand from at least the Nukumaruan onward. Poor preservation or lack of suitable bio-facies may have precluded collection of older material.

***Haliotis (Paua) flemingi* Powell, 1938**
(Figs 33, 34)

MATERIAL

Holotype. AK70349, complete specimen with some adherent matrix.

TYPE LOCALITY

Bostaquet Member, Cape Rodney Formation, Kawau Subgroup (Hayward & Brook 1984), basal Waitemata Group (Ballance 1974), Akarana Supergroup (Ballance *et al.* 1978); in sandy limestone, Fossil Point, east side of Bostaquet Bay, Kawau Island.

AGE

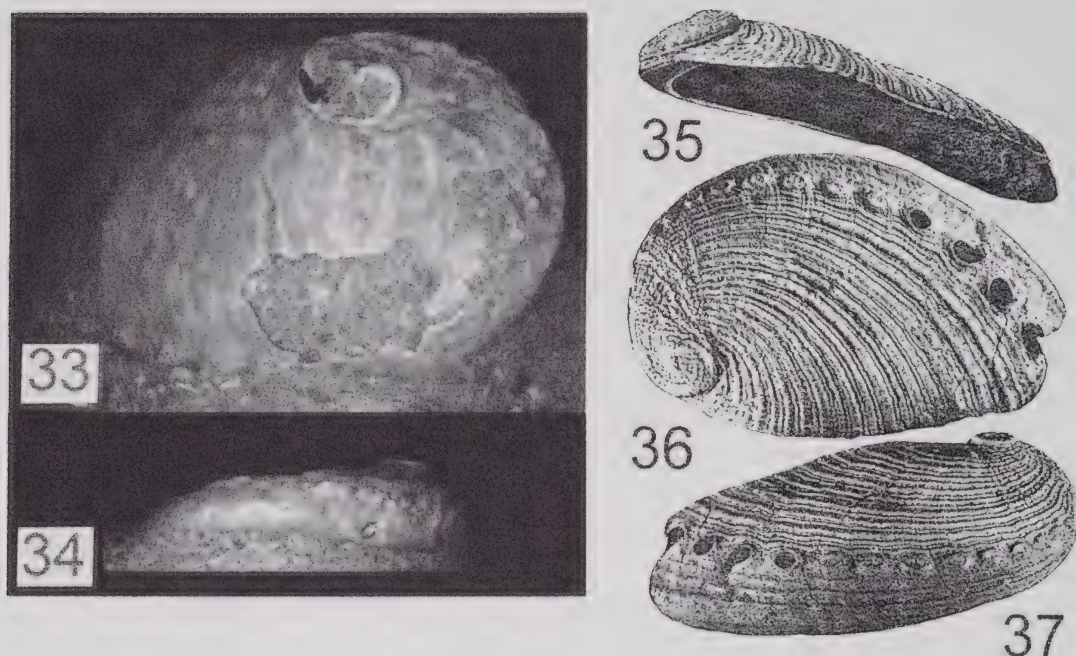
Early Otaian (Burgidalian), Early Miocene (Eagle *et al.* 1994).

DESCRIPTION

Shell moderate size, ovate, depressed; sculpturing irregular, arcuate, forwardly-directed radial folds, without spiral sculpture; 14 radial folds on last whorl; nucleus at about $\frac{1}{3}$ of length from left margin (allowance made for slight distortion); tremata slightly raised, 14 on last half-whorl; space smooth between tremata; space smooth on lower margin of shell. DIMENSIONS: Length 78 mm, width 55 mm, height (estimated) 19 mm.

REMARKS

Powell (1938: 377) wrote, "this species is ancestral to the Recent *australis* Gmelin, from which it differs in the absence of spiral sculpture, fewer radials, and the nucleus being nearer the



Figs 33–37. 33–34. Holotype of *Haliotis (Paua) flemingi* (AK70349). Length 78 mm. 33. Dorsal. 34. Posterior. 35–37. Holotype of *Haliotis (Sulculus) powelli* (GS3893.1; from Fleming 1952). Length 47 mm. 35. Anterior. 36. Dorsal. 37. Posterior.

middle". Powell's description of *H. flemingi* is diagnostic of the subgenus *Paua* (Eagle 1996, 1999), and not *Sulculus* to which it was assigned by Beu *et al.* (1990: 402). Beu *et al.* (1990: 347) state that "*H. flemingi* is much flatter and more prominently sculptured" than the Haweran to Recent *H. (Padollus) australis* and *H. (Paua) virginea*. Powell differentiated the Recent *H. (Padollus) australis* from the fossil *H. (Paua) flemingi* on the basis of shell morphology. Beu *et al.* (1990: 347) consider *H. (Paua) flemingi* as being "more coarsely sculptured, and with a narrower columellar lip than *H. (Paua) iris*". Because *H. (Paua) flemingi* exhibits shell characteristics similar to that of *H. (Paua) iris*, it is more likely an ancestor to that species.

SUBGENUS *Sulculus* Adams & Adams, 1854

Type species: *Haliotis incisa* Reeve, 1846 (by subsequent designation Crossmann, 1918). Recent, Japan.

New Zealand species: *H. powelli* Fleming, 1952.

DIAGNOSIS

Small to medium-sized *Haliotis* with tremata on angulation separating upper whorl surface from concave outer face; sutural ramp ornament of spiral striae or cords with irregular transverse ridges or nodes.

COMMENTS

Fleming (1952) synonymised *Notohaliotis* and *Sanhaliotis* with *Sulculus* as Cotton (1943), in his review of Australian Haliotidae, had failed to indicate diagnostic differences amongst them

in his key. However, Knight *et al.* (1960: 1222) recognised “only one genus, divided into several more or less intergrading subgenera”, including *Sulculus*.

***Haliotis (Sulculus) powelli* Fleming, 1952**

(Figs 35–37)

MATERIAL

Holotype. GS3893.1, complete shell.

TYPE LOCALITY

W15/f7501, exposed face of sea cliff behind Ohope Beach, Whakatane, Bay of Plenty.

AGE

Castlecliffian.

DISTRIBUTION

There may be several undescribed New Zealand fossil haliotid species. Carter (1972) recorded a possible Nukumaruan occurrence of *Haliotis (Sulculus)* aff. *powelli* (OU7674) from N44/f565, Pohangina Valley, eastern Wanganui Basin. Lee *et al.* (1983) recorded an Oligocene *Haliotis* sp. from Mt. Luxmore, Fiordland, which may be *H. (S.) powelli*, or at least have affinities with it.

RANGE

?Oligocene – ?Nukumaruan – Castlecliffian (Putikian Substage) (Carter 1972, Lee *et al.* 1983, Beu *et al.* 1990).

DESCRIPTION

Shell small, elongate-oval, weakly inflated; low spiral apex; large, medially depressed last whorl with shallow spiral area between tremata and suture; large aperture; four open tremata low toward columellar lip; sealed tremata form a spiral row of low nodes; outer lip sinuous with median concavity corresponding with depressed area, rising steeply outside marginal tremata; inner and outer lips arched gently above basal horizontal plane; sutural ramp ornament of 21 prominent, narrow, rounded spiral costae, interspaced with several finer lirae crossed by irregular, weak to prominent growth ridges; periphery angled with sharp spiral cord with second cord between periphery and outer edge of columella, an additional three unevenly spaced rounded cords in a shallow depression between periphery and perforations. DIMENSIONS: Length 47 mm, width 30.5 mm, height 8.2 mm.

REMARKS

The small sized *H. (Sulculus) powelli*, was assigned to *Sulculus* by Fleming (1952: 230), on the basis that the subgenus “must apply to shells grouped around the type species, *incisa*, and not to shells agreeing with H. & A. Adams’ diagnosis”. He thought *Sulculus* to be the earliest name for small oval *Haliotis* with the pillar coiled in an open spiral, sculptured by spiral cords, crossed by growth-lamellae or radial ribs in some species, with an eccentric nucleus, lacking the characteristic dorsal fold of *Padollus* and its allies. Shell ornamentation and trematal orifice size is similar to *Marinauris*, but *H. (Sulculus) powelli* has only four open tremata instead of six (sited on low, not conical tremata), the labial area forms a projecting flange, and a strongly eccentric nucleus; these characters prevent allocation to that subgenus.



Fig. 38. *Haliotis* (*Sulculus*) aff. *powelli* (from Carter 1972). Length 11 mm. Dorsal.

Geiger & Groves (1999: 885) thought that the *Haliotis* sp. recorded by Lee *et al.* (1983) corresponded “exactly to the type of *H. powelli* illustrated in Beu *et al.* (1990)”. In the appendix of that paper they list (p. 883) the Mt. Luxmore, Fiordland, specimen as Late Miocene, not Oligocene as correctly recorded in the references (p. 880). The Mt. Luxmore specimen is here considered to have affinities with *powelli*; further study may resolve whether it is con-specific with that species. *H. (Sulculus)* aff. *powelli* (Fig. 38) when compared to *H. (S.) powelli*, is not as elongate-oval, lacks a shallow spiral area between tremata and suture, has smaller tremata openings, and a sutural ramp ornament of 15 (not 21) rounded spiral cords. The Pohangina Valley specimen of *H. (Sulculus)* aff. *powelli*, unlike *H. (S.) powelli*, possesses three very broad cords evenly spaced from one another across the sutural ramp, interspaced with narrow spiral cords crossed by irregular weak to prominent, almost nodulose growth ridges.

Fleming (1952: 231) stated that, “of the species available for comparison, *H. (S.) powelli* is closest to *H. coccoradiata* Reeve (Recent, New South Wales, Victoria)”. Recent Australian *H. clathrata* Reeve, 1846 (Figs 20, 21) is also very similar in shell morphology to *H. (Sulculus)* *powelli*, suggesting perhaps hybridisation from an ancestral Australian species before the Pleistocene.

DISCUSSION

Beu *et al.* (1990: 154) record New Zealand fossil haliotids as “. . . ranging in age from Mangaorapan to Opoitian . . .” (late-early Eocene to early Pliocene). Pleistocene and Holocene *Haliotis* specimens also occur. The fossil record suggests that New Zealand fossil, as well as Recent *Haliotis* species, are endemic, possibly the result of a long period of geographic isolation. Recent *Haliotis* planktonic larval stages vary with species (80–100+ days). Given ideal conditions, *Haliotis* should be able to migrate/colonise over great distances. Environmental factors may limit distribution, since this is not so for New Zealand.

Ten New Zealand fossil *Haliotis* species are allocated to six subgenera with few apparent lineages. Compared to the New Zealand fossil fauna, *Haliotis (Padollus) mooraboolensis* McCoy, 1876 from the late Miocene of Flemington, Victoria, Australia, is most similar to

H. (P.) matihetihensis, but different in having prominent, evenly spaced, low spiral ribs over the whole upper surface and a less depressed spire. The late Miocene-Pliocene Australian haliotid, *H. (Notohaliotis) naevosoides*, also from Flemington and elsewhere in Victoria, appears similar in overall shape and sculpture to *H. (Euhaliotis) mathesonensis*, but differs from that species in having a more eccentric, posteriorly sited spire, radial lirae oblique to collabral lines, less pronounced tremata, and no distinct, projecting notched labial flange. *H. (E.) mathesonensis* also appears similar to *H. (E.) midae* of South Africa. Another late Miocene haliotid from Victoria, Australia, *H. (Ovinotis) ovinoides* McCoy, 1876, is unlike any New Zealand fossil species, having tremata on large tubular projections, a knobby ornament on the sutural ramp, transverse ribs oblique to collabral lines, and obscure spiral threads. Lindberg (1992) recorded the extant Australian haliotid species *H. (Padollus*; emend Lee & Vacquier 1995) *cyclobates*, *H. (Padollus) emmae*, *H. (Padollus*; emend Lee & Vacquier 1995) *laevigata*, and *H. (Padollus*; emend Lee & Vacquier 1995) *ruber* as Pleistocene fossils from Victoria. Of these species, only *H. (P.) emmae* appears to have similar characteristics to a New Zealand fossil species, namely the early Miocene *H. (Notohaliotis) waitemataensis*.

Six New Zealand fossil haliotids are older than those presently known fossil from Australia, a situation possibly caused by the lack of suitable rocky shore facies there. The Australian late Miocene fossil *H. (Padollus) mooraboolensis* appears to have affinities with the New Zealand early Miocene species *H. (P.) matihetihensis*. The latter is also similar to the South African Recent species *H. (P.) parva* Linné, 1758. Several of the Recent Australian species have morphological characteristics similar to the older haliotids of New Zealand (e.g. *H. (Marinauris) ethologus* and *H. (M.) hokiangaensis*), and the New Zealand extant species *H. (Padollus) australis* has shell characteristics similar to those of the Recent Australian species *H. (P.) ruber*. The apparent incidence of New Zealand Cenozoic haliotids possessing shell characteristics of later Australian and South African taxa may be a result of convergent evolution in a local environment, but more likely a radiation eastwards from New Zealand in the late Oligocene onwards, when the circum-Antarctic Current began to flow and possibly distribute spawn.

In a cladistic analysis, Geiger (1999: 65) explained New Zealand's Recent endemic haliotid populations by suggesting "that these three species [*H. (Paua) iris*; *H. (Padollus) australis*; *H. (Paua) virginea*] seem to result from individual colonisations of the islands as contrasted with a small radiation in this rather isolated region. The basal split of *H. australis* from the remaining Australian species makes intuitive sense. The position of the other two taxa is more challenging to interpret". *H. (Paua) iris* would appear the oldest extant *Haliotis* species (Lee & Vacquier 1995; Geiger 1999) and with *H. (Paua) virginea* appear to have come from "some general south Indo-Pacific region". DNA inference in Recent New Zealand *Haliotis* suggests the possibility that in the late Palaeogene-early Neogene New Zealand haliotids were a result of local radiation from either ancestral Tethyan or Panthalassian Ocean progenitors. Subsequent geographic isolation and dispersal of New Zealand haliotids may have occurred in the fossil record at different times for different environmental reasons.

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[SHORT NOTE]

RECORDS OF BATS (MAMMALIA: CHIROPTERA) FROM LATE HOLOCENE DUNE-SANDS AT TE WERAHI BEACH, NORTHLAND, NEW ZEALAND

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Abstract. Four fragmentary fossil remains of bats (two teeth, a worn humerus and a fragment of radius) are reported from sand-dune sites near Te Werahi Beach, Northland, and are of Late Holocene age. They are the first bat fossils reported north of Waitomo (central North Island), and are identified as belonging to *Mystacina tuberculata*, *M. robusta* and *Chalinolobus tuberculatus*. Thus all three species were once sympatric in the Far North as at various other places throughout New Zealand.

KEYWORDS: Microchiropteran bats; fossil remains; Holocene; Northland; New Zealand.

INTRODUCTION

Faunal remains, particularly bones, from Holocene deposits in New Zealand form an important picture of the diversity and distribution of land vertebrates in the period immediately before the arrival of humans. Among small bones and bone fragments collected by Dr F.J. Brook in 1995 at Te Werahi Beach, Cape Maria van Diemen area, Northland, I recognised four fragments belonging to bats. They are now in the collection of Auckland Museum. Though fragmentary, the remains are noteworthy, given the lack of records of the fossil distribution of bats in Northland.

New Zealand has three species of microchiropterans—a *Chalinolobus* (Vespertilionidae) and two species of *Mystacina* (Mystacinidae). Their bones are small and thin, and only rarely survive in, and are recovered from, fossil deposits, although mystacinid bats may be well represented in food remains accumulated by predators (e.g. Worthy 2001). Daniel (1990) and Worthy *et al.* (1996) discussed the distribution of “subfossil” records of New Zealand bats. In the North Island there are no fossil bat records north of the Waitomo area (central North Island), where all three species are known from fossils. As for historic distributions, *M. robusta* is believed to be extinct and all living specimens were collected on islets off Stewart Island, and perhaps at Collingwood, northern South Island (Worthy *et al.* 1996). *M. tuberculata* and *Ch. tuberculatus* are still extant in Northland (Daniel 1990).

REFERENCE MATERIAL

The fossil remains from Te Werahi were identified by comparison with diagrams in Vaughan (1970), and with the following reference skeletons in the Auckland Museum collection:

Mystacina tuberculata. M36 (cranial and post-cranial) and M512 (post-cranial), Little Barrier

Island. M311 (skull and mandibles), male, Omahuta, Northland. M301 (skull and mandibles), male, Te Rimu area, upper Waimarino River.

Chalinolobus tuberculatus. M34 (cranial and post-cranial), Rewiti, Northland.

STUDY AREA

The northern tip of the North Island has a coastline of rocky headlands linked by sandy beaches. Dunefields behind Te Werahi Beach are presently sparsely vegetated and mobile, but palaeontological evidence shows that they were forested at various times during the past 4,000 years (Brook 1999). The most recent disturbance of the dune forest was its destruction 800–550 years BP, following Polynesian settlement in the area.

The bat remains at Te Werahi were found in sandy palaeosols at two sites. One site (Fossil Record File number M02/f85; grid reference NZMS 260, M02/809483; shown as Site 21 in fig. 1 of Brook 1999) contained a diverse landsnail fauna indicative of a forest setting. Radiocarbon dates on shells of the landsnail *Placostylus ambagiosus* gave a calibrated age of 2886–1996 years BP for M02/f85 (Brook 1999).

At the other site (M02/f110; NZMS 260 M02/815498; seaward of Site 29 in fig. 1 of Brook 1999) rhizomorphs of trees and shrubs were common (F.J. Brook, pers. comm.). The fossil fauna at M02/f110 has not been dated, but is inferred from stratigraphy to be younger than 4400 years BP (F.J. Brook, pers. comm.).

RESULTS AND DISCUSSION

The following four bat remains were identified:

Mystacina tuberculata

- (1) Upper left canine (M879) from M02/f85. Total length, including root, 4.2 mm. The enamelled half of the tooth closely matches in shape and size the corresponding teeth in skulls of the reference examples of *M. tuberculata*.
- (2) Proximal end of radius (M880) from Te Werahi Beach area (precise site at Te Werahi not known as site number was mislaid during museum processing). In size and shape this closely matches reference samples of *M. tuberculata* but differs in shape from the example of *Chalinolobus*.

Mystacina robusta

- (3) Lower left canine (M878) from M02/f85 (Fig. 1). Total length, including root, 5.2 mm. It is similar in shape to reference examples of this tooth in *M. tuberculata* (example shown in Fig. 1), but is much larger. It is assigned to *M. robusta* on size. It differs slightly from *M. tuberculata* in being less recurved towards the posterior, a feature not evident from the angle in Fig. 1.

Chalinolobus tuberculatus

- (4) Left humerus (M877) from M02/f110. Total length 23.6 mm, but ends worn. Despite wear obliterating various features of this bone, I have assigned it to *Chalinolobus tuberculatus*, because the shape of the trochlea at the distal end clearly matches the condition in the latter species rather than in *Mystacina tuberculata*.

The fossil remains reported here establish that all three species of New Zealand bats were present in the Far North within the last few thousand years. The two species of *Mystacina* were



Fig. 1. Lower left canines of contemporary *Mystacina tuberculata* from Little Barrier Island (M36, right) and fossil *M. robusta* from Te Werahi (M878, left). The larger tooth (including root) is 5.2 mm long. Photo: T. Landers.

sympatric and contemporaneous in the Te Werahi area, as indicated by their presence at site M02/f85. *Chalinolobus* may or may not have been contemporaneous with the mystacinids. Not surprisingly, the sites were forested at the times the bats lived there.

The record of *Mystacina robusta* extends the known distribution of this large extinct species to the northern end of the country. It was previously not known north of Waitomo (Worthy *et al.* 1996).

Acknowledgements. I thank Fred Brook for presenting to Auckland Museum the vertebrate material collected during his study of fossil land-snails at Te Werahi; S. Ingleby (Australian Museum) and Trevor Worthy for providing diagrams that helped with the identification of the bat bones; Todd Landers for taking the photograph; and Fred Brook for helpful comments on a draft of this note.

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[SHORT NOTE]

NEW DISTRIBUTIONAL RECORDS OF THE EXTINCT NEW ZEALAND DUCK *MALACORHYNCHUS SCARLETTI* (ANATIDAE)

T.H. WORTHY AND B.J. GILL

Abstract. A left humerus from dunes at Te Werahi Beach, Cape Maria Van Diemen, Northland, and several bones from Lake Poukawa, Hawke's Bay, are identified as belonging to the extinct New Zealand pink-eared duck *Malacorhynchus scarletti*, previously known in the North Island only from the Hastings area. An additional *Malacorhynchus* bone is reported from Marfells Beach. The species is also confirmed as a former inhabitant of the Chatham Islands. The minimum number of individuals in the fossil record now stands at 19, from seven Holocene fossil sites.

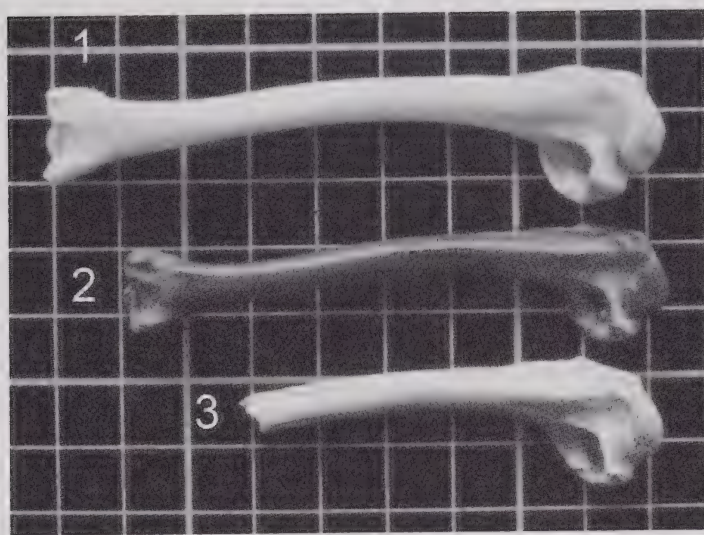
KEYWORDS: Holocene fossils; *Malacorhynchus*; distribution; Northland; Hawke's Bay; Marlborough; Chatham Island.

INTRODUCTION

The extinct New Zealand pink-eared duck *Malacorhynchus scarletti* Olson, 1977, was previously known from bones found at three South Island sites—Marfells Beach (Marlborough), Pyramid Valley swamp (north Canterbury) and Ngapara (Otago)—and a swamp near Hastings, North Island (Worthy 1995, 1998a, 1998b). The holotype was a fragment of premaxilla from Pyramid Valley (Olson 1977). The minimum numbers of individuals represented by these bones are two at Marfells Beach (Worthy 1998a), four at Pyramid Valley (Worthy 1995), one at Ngapara (Worthy 1998b), and one by a single bone from Hastings, making a total of eight individuals.

Given the rarity of this species in the New Zealand fossil record, the purpose of this note is to report additional Holocene fossil bones in New Zealand museums that THW recently identified as belonging to *M. scarletti*, and that represent significant extensions to the known range of this duck. The following institutional acronyms are used: AIM (Auckland Museum, Auckland), CM (Canterbury Museum, Christchurch), and MNZ (Museum of New Zealand Te Papa Tongarewa, Wellington).

The left humerus of *M. scarletti* from near Hastings, which was discussed by Worthy (1995), had been inadvertently registered into the Auckland University Geology Department collection as AU9534, but has now been returned to AIM and registered as B8830 (Fig. 2). It was with a collection of moa bones from a swamp near Hastings purchased by the museum in 1933 from Mr D. Clark.



Figs 1–3. Left humeri of New Zealand ducks.

1. *Anas superciliosa*, AIM B9190, Otorohanga (contemporary specimen).
 2. *Malacorhynchus scarletti*, B8830, Hastings (fossil).
 3. *M. scarletti*, B9400, Te Werahi Beach (fossil).
 Side of background square = 10 mm.
 Photo: B. Gill.

NEW RECORDS

NORTHLAND

A left humerus of *M. scarletti* (AIM B9400; Fig. 3) was collected by F.J. Brook in 1995 in dunes behind Te Werahi Beach (173° 40'E, 34° 27'S), Cape Maria Van Diemen, Northland. It preserves only the proximal end and shaft. B9400 is very close in size to B8830 from Hastings (Fig. 2). The proximal widths are 18.1 mm and 17.4 mm respectively. The proximal end clearly has a concave external surface to the deltoid crest, a raised external tuberosity, a compressed and well-developed capital shaft ridge, and a closed bicipital foramen, which are all diagnostic of *M. scarletti*.

B9400 is from Fossil Record File Number M02/f86 (grid reference: NZMS 260, M02/811484), a Holocene fossil site close to the present course of the Te Werahi Stream and to the Te Werahi wetland, a large area of swamp (Brook 1999). Fossil landsnail shells from the site have been dated with a radiocarbon age range of 2014–1832 years BP. During this period the site where the bone was found would have been swamp, or close to swamp, with adjacent forest (Brook 1999).

HAWKE'S BAY

The avifauna from Lake Poukawa (176° 44'E, 39° 46'S), Hawke's Bay, is derived from several sites, the fauna of only one of which has been reported previously (Horn 1983). *Malacorhynchus* bones were not recognised in that study and were confused with those of *Anas superciliosa* when the entire Poukawa collection was catalogued into the MNZ collection. Several bones have now been re-identified as *M. scarletti* (Table 1). Only part of the large collection of *Anas superciliosa* bones from Lake Poukawa has been reassessed by THW, so further specimens of *Malacorhynchus* are expected to be found. Meanwhile, these records reveal Lake Poukawa to have been a significant locality for this species.

MARLBOROUGH

A *Malacorhynchus* bone identified from dunes at Marfells Beach (174° 12'E, 41° 43'S; Table 1) is additional to those previously reported (Worthy 1995, 1998a). It increases the minimum number of individuals from the site to three.

CHATHAM ISLAND

Two right humeri of *M. scarletti* (CM Av27727a & b), labelled from Long Beach, Chatham Island, were considered by Worthy (1995) to have probably been incorrectly referred to this locality. However, two bones from Chatham Island (Table 1), collected in dune localities by P.R. Millener, confirm the presence of this duck on Chatham Island. The CM specimens are therefore now accepted as having originated from Chatham Island.

DISCUSSION

On current evidence, *Malacorhynchus scarletti* appears to be a rare species in the New Zealand fossil record. However, its incidence is bound to increase as more fossil bones are collected and more attention is paid to the correct identification of duck bones. Cranial bones and humeri of *M. scarletti* are easily distinguished from these elements in the similar-sized *Anas superciliosa*, but most other elements are either not yet described in the former species or not easily distinguished.

The new records of *M. scarletti* reported here increase the number of fossil sites from which it is known to seven: the Chatham Islands plus three North Island and three South Island sites. The minimum number of individuals represented is increased to 19, as follows: Chatham Island (4), Te Werahi (1), Hastings (1), Poukawa (5), Marfells Beach (3), Pyramid Valley (4) and Ngapara (1).

Table 1. New records of *Malacorhynchus scarletti* from the AIM and MNZ collections.

| Reg. Number | Locality | Specimen |
|-------------|---|------------------|
| AIM B9400 | Te Werahi Beach | L humerus |
| MNZ S1276 | Poukawa, site XII | L humerus |
| MNZ S1823 | Poukawa, site XII | R humerus |
| MNZ S2379 | Poukawa, site XII | R humerus |
| MNZ S17115 | Poukawa, site I.47 | R humerus (juv.) |
| MNZ S17299 | Poukawa, site I.93 | L ulna |
| MNZ S22165 | Poukawa, ?site XII | L ulna |
| MNZ S22402 | Poukawa, site II | R humerus |
| MNZ S36338 | Lake Grassmere (= Marfells Beach) | R humerus |
| MNZ S26771 | Long Beach, grid ref. 456646, Chatham Island | L humerus |
| MNZ S33043 | Long Beach, grid ref. 445669, Chatham Island | R humerus |

All fossil sites for *M. scarletti* are close to extant or former wetlands. Most bones have come from former lacustrine environments (Lake Poukawa, Pyramid Valley, and Marfells Beach) as expected for an obligate filter-feeding duck. This habitat is rarely represented in fossil sites, which in turn probably largely explains the scarcity of the duck in the fossil record. The species was not recorded from any of the faunas from the important archaeological sites close to estuarine habitats in Otago (Warrington, Pleasant River, Shag Mouth, Papatowai, Pounawea) whose faunas were reviewed by Worthy (1999), yet other taxa that went extinct immediately after human contact on the mainland were present, e.g. *Chenonetta finschi*, *Mergus australis*. These observations suggest the species was absent from estuaries.

There is nothing about the osteology of *Malacorhynchus scarletti* to suggest it was a poor flier, so it is not unexpected that it would reach Chatham Island, as *Anas platyrhynchos* regularly does. The availability of extensive lacustrine habitats suitable for filter-feeders means that Chatham Island probably had a resident population of *M. scarletti*.

Acknowledgements. We thank Fred Brook for presenting the duck humerus from Te Werahi to AIM, Alan Tennyson (MNZ) and Geoff Tunnicliffe (CM) for access to specimens in their care, and Ewan Fordyce for comments on a draft of this note.

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